system which would be readily adaptable to all requirements, visual or spectroscopic.

The observations of Sirius have been made under varying conditions, instrumental and otherwise, and a better accordance in the individual results might be obtained by making the observations under uniform conditions. The resulting value, obtained from all the plates, gave the velocity of the system of Sirius as −7·36 km. per second. There is a marked progression among the individual values obtained for the velocity of the primary which is attributed to the effect of orbital motion. The sense of this progression indicates that the positive value of *i* (the inclination of the plane of the orbit) should be used. The above value, whilst disagreeing with others, agrees very well with the value obtained by Profs. Frost and Adams in 1901–2.

The values of the radial velocities of the centre of the system and of the primary and secondary components are given in a table, with yearly intervals, for a whole revolution, *i.e.* from 1870·09 to 1918·09, the time of the apastron passage being 1918·5110.

CONSTANT ERRORS IN MERIDIAN OBSERVATIONS.—In an address delivered to the astronomy section of the St. Louis International Congress of Sciences and Arts, Mr. J. G. Porter discussed the various sources of error to which meridian observations are peculiarly subject, and proposed various methods whereby the constant errors might be eliminated.

Among other methods for eliminating the magnitude error which affects right ascension determinations, he recommends the one proposed by Prof. Turner wherein the transits would be registered on a regularly moving photographic plate, the reticule wires being replaced by spots of light projected on to the plate at regular intervals from a fixed source.

Regarding declination observations, the error due to varying refraction is the most important, and Mr. Porter suggests that this might be eliminated by having a perfected system of fundamental stars well distributed over the sphere, from observations of which, on any evening, the deviation of the actual refraction from the assumed law might be determined and used to correct the observations. Another, more costly, method would be to have a number of observatories widely distributed in latitude, so that zenith observations, where refraction is non-effective, of more stars might be made. Mr. Porter considers the solution of this constant error difficulty in meridian observations to be one which is eminently suitable for international cooperation (*Popular Astronomy*, No. 3, vol. xiii.).

THE NATIONAL PHYSICAL LABORATORY.

ON Friday last the annual general meeting of the governing body of the National Physical Laboratory was held at that institution, when the report of work done in 1904 was received and the programme of work proposed for the forthcoming year approved. A number of guests were invited to meet the members of the general board and inspect the laboratory. Among those present were about thirty Members of Parliament, several colonial agents-general, and a representative gathering of leading physicists and engineers.

In the 45-page report submitted by the director, Dr. Glazebrook, are found particulars regarding the various researches and tests carried out during the past year, with special reference to the newer developments. The test work at Bushy for the year shows a marked growth, the total number of separate tests made having increased from 1330 in 1903 to 1906 in 1904, the increase being spread over almost all the different departments of the laboratory. These figures are distinct from the work of Kew Observatory, where in all more than 26,000 instruments were verified during the year.

In the engineering department, Dr. Stanton has made considerable progress with the research on the distribution of wind pressure over large areas, which forms a continuation of the important work embodied in his paper read at the Institution of Civil Engineers last session. A steel tower fifty feet high has been erected in the grounds, carrying large and small pressure plates with the necessary gauges. From the general results of the observations made it would appear that the distribution of pressure on the windward side of a large plate in the open air falls off more rapidly from the centre to the sides than in the case of a small plate, but that the ratio of the pressures on the windward and leeward sides appears to be practically the same in both cases.

The research on the specific heat of superheated steam by the continuous flow method has been continued by Mr. Jakeman, who has been mainly occupied in contending with certain experimental difficulties, such as the attainment of sufficiently high insulation between the various parts of the electrical superheater, especially at low superheats. Some preliminary figures have been obtained which do not appear to confirm the rapid rise in specific heat shown by the results of some recent observers.

A testing machine for studying the effect of alternating stresses of varying periodicity on engineering materials has been constructed and was described in last month's *Engineering* by Dr. Stanton. It has already been used on a set of nickel-steel specimens, which are the basis of a research in the metallurgical department.

A new building has been erected to house the new standard leading-screw machine, which is now at work. Several standard screws have been cut and measured for use in Government arsenals.

Dr. Chree, at the observatory department, has been occupied with some important investigations on terrestrial magnetism, and the measurement and tabulation of some of the old Kew magnetic records. The men of science of the British Antarctic Expedition have, since their return in September last, had the opportunity of again comparing with recognised standards many of their instruments, and arrangements have been made for cooperation with them in the reduction of the mass of magnetic and meteorological data they brought home with them.

In the physics department numerous researches have been in progress. We have only space for mention here of some of the more important. Dr. Harker, in the thermometry division, has been occupied with preliminary work on which it is hoped may ultimately be based some new direct electrical method of very high temperature measurement. With this object he has undertaken a study of the resistance and thermoelectric properties of solid electrolytic conductors such as are used in Nernst lamps. The existence at high temperatures of large thermoelectromotive forces between rods of the various earths made up as ordinary thermojunctions has been securely established by direct electrometric methods, and a new form of electric furnace has been designed capable of continued use at temperatures above 2000° C. By means of these furnaces and a number of thermojunctions of widely different properties, a careful re-determination of the melting point of platinum was made. More than sixty determinations concorded in giving a value which differs considerably from that now accepted. The results of this work are embodied in a paper just sent in to the Royal Society.

The research on the specific heat of iron, which has been extended to temperatures above 1100° C., is complete, and will shortly be published.

In the electrical standards department, Mr. Smith has been mainly occupied with work on the standard ampere balance designed by the late Prof. Viriamu Jones and Prof. Ayrton for the British Association committee on electrical standards. The weighing mechanism was constructed by Mr. Oertling, and the four marble cylinders carrying the coils have been successfully wound and insulated at the laboratory. On each cylinder are two double helices of bare copper wire. Though the air space between the consecutive turns is less than 0·006 inch, an insulation resistance over 30,000 megohms was finally secured for each of the coils. Many accessories have been constructed, and the outlook for a speedy determination of the absolute unit of current to at least one decimal place further than hitherto attained is very hopeful.

In electrotechnics, Mr. Paterson has installed large cells for ammeter verification, and for alternate current measurements a specially constructed set of Mr. Addenbrooke's instruments, and a Kelvin voltmeter with circular scale of 2½ metres radius. In photometry have been included in-

vestigations on several Harcourt 10-candle pentane lamps and a number of Fleming large bulb standard electric glow lamps, which now form the working standards of candle-power. Intercomparisons have been made by means of glow lamps with the National Standards Bureau of Washington, the Electrical Standardising Laboratories of New York, and the Berlin Reichsanstalt.

In the general electrical department, Mr. Campbell has devised a method for obtaining for inductance measurements alternating currents having very high frequencies and a wave form almost a pure sine-curve. A large amount of new apparatus has been set up for testing purposes, much of it of a novel character.

The standard current balances and electrostatic voltmeters have been studied, and it has been found that the allegation that the Kelvin balance, when used with alternating current, is affected by eddy currents in the metal parts near the coils is without foundation for all ordinary frequencies.

Researches on the distribution of temperature in field coils of dynamos and motors, and on the behaviour of insulating materials under heat treatment, have been made by Mr. Rayner, and form the subject of a report to the engineering standards committee communicated to the Institution of Electrical Engineers at their last meeting.

In the department of metallurgy, Dr. Carpenter and Mr. Keeling, during the early part of the year, completed their work on the range of solidification and critical ranges of iron-carbon alloys, and an account of the work was read at the meeting of the Iron and Steel Institute in May last. The value of Dr. Carpenter's work was recognised by his election as Carnegie scholar. On Mr. Keeling's leaving the laboratory, Mr. Longmuir, also a Carnegie scholar, was appointed on the staff, and Dr. Carpenter and he have since been carrying on, in cooperation with Mr. Hadfield of Sheffield, an elaborate systematic research on the properties of the nickel-steels. In all, seventeen different kinds of physical, mechanical, and chemical tests have been performed on the different samples used, which contained varying amounts of nickel up to 16 per cent. The results obtained will shortly be submitted to the alloys research committee of the Institution of Mechanical Engineers.

An investigation on modern high-speed tool steels, such as those shown in use in the engineering department on Friday last, has also been completed by Dr. Carpenter, cooling curves and photomicrographs having been obtained showing clearly the various modifications in structure after different heat treatment.

The optical department is rapidly being organised, and, in addition to lens testing, the work has included the accurate measurement of the angles of prisms and determination of the optical constants of numerous samples of glass.

In the weights and measures department, the chief work has been the study of the master screw of the new leading-screw lathe, which has been carefully calibrated throughout its entire length.

The foregoing serves to indicate the substantial progress made by the laboratory, and to prove that though it has only been at work a little more than three years, it has already begun to make its mark on the science and industry of the country, and to justify in a large measure the expectations of its promoters.

FUNGI.[1]

HAVING pointed out that the attempts to derive the word fungus from *funere*, or *funus* and *ago*, *fungor*, &c., have been shown to be failures—that it comes from the Greek *σπογγος*, and is the same word as sponge, the lecturer proceeded to give illustrations of the fungi known to the ancients. These were, of course, all of the larger kinds, since no knowledge of micro-fungi was possible. Nevertheless, references in the Old Testament show that certain diseases—mildew, smuts, &c.—were known to the Hebrews, but of course their connection with fungi was not suspected.

[1] Abstract of a discourse delivered at the Royal Institution on February 24 by Prof. H. Marshall Ward, F.R.S.

The Greeks and Romans not only knew several forms of Amanita, Agaricus, Boletus, Polyporus, and of Truffles, Morels, &c., but they discriminated clearly between the poisonous and wholesome species.

Their ideas as to the nature and origin of such fungi seem childish to us, but they were consistent with the naïf attitude of the Greeks towards natural objects. Theophrastus, about 320 B.C., Dioscorides, about 60 B.C., and Pliny, for example, argued that since truffles and other fungi had no roots, leaves, stems, &c., they are objects apart. They arise spontaneously from earth, or by fermentation from the sap of trees, or from water.

It is interesting to note that *Polyporus officinalis* was imported and used as an article of medicine not only during classical times, but also for centuries afterwards.

In mediæval times the herbalists chiefly copied from Galen, Theophrastus, &c., and as they had no figures the early herbals give us little information. In 1576, however, Clusius gave a series of wood-cuts which are well worth looking at, and in 1601 he made a series of water-colour sketches of eighty-two of the fungi of Austria—the first drawings of the kind known. Figures in Dalechamps, 1536, Dodoens, 1583, and Parkinson, 1640, may also be compared.

The next step forward was only possible after the microscope had come into use as a scientific instrument.

It is a curious point that abundant and conspicuous as the powdery spores of the fungi are, no one seems to have observed their importance until Micheli, in 1729, collected and sowed a series of them, and with results, for he obtained mycelia, and in a few cases even sporophores; but it was not until a century later, 1820, that Ehrenberg, in his classical "De Mycetogenesi," traced the larger fungi to their mycelial filaments, collected and sowed spores, and grew several species of Moulds, and especially discovered the sexual act in Zyzygites. For although Micheli's ideas had been confirmed by Gleditsch in 1753 and by Schaeffer in 1762, Rudolphi and Persoon had more or less denied the germination of spores, and insisted on the spontaneous generation of the moulds.

However, before 1840 Nees von Esenbeck had cultivated a Mucor from spore to spore, and Dutrochet, 1834, and Trog, 1837, had seen the "puffing" of asci and practically established the doctrine of wind-distribution of spores.

By these and similar successes the era of the Mould-fungi was initiated, and the labours of Corda, Tulasne, Pringsheim, Cohn, and De Bary soon introduced system into their study, and especially the exact study of life-histories showed what important results for morphology lay in the biological investigations of these micro-fungi.

The lecturer here gave illustrations of the commoner types of mould fungi, with notes on their botanical importance, and some remarks on the points he wished to emphasise later.

An early outcome of the investigations of the moulds and their allies was the discovery of what curious substrata some of them grow upon. A rapid survey of all saprophytic fungi shows that while the majority grow on the soil, on plant remains, or on dung of various kinds, peculiar forms or species occur on such bodies as resin, cork, bees' and wasps' nests, bones, limestone, insect-remains, horn, hair, feathers and hoofs, fats, and in chemical solutions such as picric acid, copper sulphate, arsenic, and poisons such as atropin, muscarin, and so forth.

Here, also, the lecturer gave some notes on details, of which the most striking was, perhaps, his own proof that the horn-destroying fungus will not act until its spores have been passed through the alimentary tract of an animal, or subjected to the influence of gastric juice.

In 1866, the year of publication of De Bary's book on mycology, a revolution in the study of fungi was brought about by the first morphological proof of parasitism and infection, and the clear distinction drawn between the saprophytic micro-fungi or "moulds" and the parasitic fungi which induce "diseases." The matter was of especial importance as explaining away prevalent erroneous ideas according to which these disease-fungi were outgrowths (*exanthemata*) from the moribund tissues of the host-plant itself.

De Bary's great service was to prove that a spore of a fungus arrived from outside, and after germinating on the